Amendments to the Title

Please amend the Title of the Invention section to read as follows:

ARM POSITIONING APPARATUS FOR MANUFACTURING A ROTARY TYPE ACTUATOR

Amendments to Specification

Please amend the Technical Field, Background Technology and Disclosure of Invention sections of the Specification as indicated below, where strikethroughs and double brackets indicate deletions and underlining indicates additions, as follows:

TECHNICAL FIELD

The present invention relates to a rotary type actuator, used for a magnetic disk apparatus, a hard disk drive, or the like, ~~as well as~~ a manufacturing method thereof, ~~used for a magnetic disk apparatus, a hard disk drive, or the like,~~ and an arm positioning apparatus for manufacturing the rotary type actuator.

BACKGROUND TECHNOLOGY

In a rotary type actuator of a magnetic disk apparatus, a holder which is supported by a chassis so as to rotate has a plurality of arms for mounting magnetic heads and a coil part for generating a driving force. A magnet is placed in a desired position on the chassis in the configuration so that the arms are oscillated by an actuator part which is constructed of the magnet and the above described coil part. A head suspension element on which a magnetic head is provided is secured to the tip of each of these arms and is formed so that the magnetic head is shifted to a desired position according to the oscillation of the arms.

As for a conventional manufacturing method for such a rotary type actuator that shifts magnetic heads according to the oscillation of the arms, a method is known wherein grooves having a gap width slightly smaller than the plate thickness of the arms are formed in the external surface of the holder wherein one end of an arm is pressed into one of the grooves so as to be secured. After that, the holder, the arms and the coil part are mutually secured by injection molding a resin around the holder.

In the following, the conventional manufacturing method for a rotary type actuator is described in reference to FIGS. 6 and 7.

~~Apart~~ Part (a) of FIG. 6 is a plan view of a conventional rotary type actuator and [[a]] part (b) of FIG. 6 is a cross sectional view along line IV(b)-IV(b) of [[the]] part (a) in FIG. 6. FIG. 7 is a perspective view showing some portions in a penetrative manner in the condition after forming the conventional rotary type actuator.

As shown in [[the]] parts (a) and (b) of ~~FIGS.~~ FIG. 6, a plurality of grooves 101a which have a gap width slightly smaller than the plane thickness of arms 102 are formed in the external surface of a holder 101, and an arc portion which makes up one end of each arm 102 is pressed into each of these grooves 110a.

It is necessary to maintain the plurality of arms 102 placed in a layered manner as described above at the same potential through grounding. As shown in FIG. 7, an earth pin 110 that is formed of a conductive material is provided so as to penetrate through each arm 102 in order to maintain the plurality of arms 102 at the same potential through grounding in the conventional rotary type actuator. A through-hole 102a having a diameter slightly smaller than the diameter of the earth pin 110 is formed in each of the arms 102. The earth pin 110 is placed into the through-hole 102a of each arm 102 so as to electrically connect the respective arms 102 at the same potential.

After that the holder 101, to which the plurality of arms 102 is secured, is placed in a predetermined position within a metal mold together with the coil part 104 so as to be injection molded with a resin. As a result, the holder 101, the plurality of arms 102 and the coil part 104 are mutually secured with a resin part 106 and, thereby, the rotary type actuator is manufactured.

In the manufacture of the rotary type actuator it is extremely important to make constant the

distance (C) between the center of oscillation (A) of the holder 101 and the center (B) of the suspension element attachment hole 102b in each arm 102 for attaching a head suspension element on which a magnetic head is mounted. In addition, in the case of the plurality of arms 102, it is necessary for the axis of each suspension element attachment hole 102b to be arranged in a coaxial manner and to be arranged in parallel to the axis of the center of oscillation of the holder 101.

FIG. 8 is a cross sectional side view showing the conventional manufacturing method for a rotary type actuator. As shown in ~~a~~ part (a) of FIG. 8, in a manufacturing step of a rotary type actuator, the holder 101 and the coil part 104 are placed in predetermined positions. And the plurality of arms 102 which are layered at predetermined intervals are positioned by a positioning pin 105 secured to the metal mold 107. ~~The positioning pin 105 has a diameter that the positioning pin 105 can be~~ The diameter of positioning pin 105 is such that it can be tightly inserted into the suspension element attachment hole 102b of each arm 102. ~~And the~~ The positioning pin 105 penetrates through each suspension element attachment hole 102b so that each arm 102 is placed in a predetermined position (predetermined position in the direction towards the center of oscillation and in the oscillation direction) The positioning pin 105 is secured so as to maintain the relationship between the center of oscillation (A) of the holder 101 and the center (B) of the suspension element attachment hole 102b. An arm 102 is placed in a predetermined position in this manner and, thereby, each suspension element attachment hole 102b of each of the arms 102 which are layered at predetermined intervals is placed in a coaxial manner with reliability.

As shown in ~~the~~ part (a) of FIG. 8, the layered arms 102 are positioned by the positioning pin 105, the holder 101 is positioned by the holder positioning pin 120, and then resin injection molding operation is carried out for forming the rotary type actuator. ~~A part~~ Part (b) of FIG. 8 shows a condition of release from the mold of a product after resin injection molding, wherein a sleeve pin 108, which is placed around the outside of the positioning pin 105, and a mold release pin 121, which contacts the bottom of the holder 101, have risen. ~~The sleeve pin 108 rises around~~

~~the outside of the positioning pin 105 and, at the same time, the mold release pin 121, which is placed outside of the holder positioning pin 120, rise in this manner and, thereby, the arms 102 of the rotary type actuator are pushed up.~~ Sleeve pin 108 rises around the outside of the positioning pin 105. Mold release pin 121, which is placed outside of the holder positioning pin 120, rises at the same time as sleeve pin 108. This operation pushes up the arms 102 of the rotary type actuator. As a result, the suspension element attachment holes 102b of the arms 102 come off of the positioning pin 105.

As described above, in the conventional manufacturing method, since the position of the arms 102 are limited by the holder 101 and the positioning pin 105, expansion of the arms 102 due to heat generated at the time of resin molding negatively affects the circularity of the suspension element attachment holes 102b, the ~~cylindrically~~ cylindrical shape of the suspension element attachment holes 102b of the layered arms 102, or the like. In addition, due to thermal expansion of the arms 102, the center (B) of the suspension element attachment holes 102b tends to shift from the center of the inserted positioning pin 105. Therefore, a great stress is caused between the positioning pin 105 and the suspension element attachment holes 102b so that the balance of each of the suspension element attachment holes 102b, which ~~that~~ are supposed to be arranged in a coaxial manner, is not ~~in some cases~~ achieved in some cases. In these ~~this case~~ cases, the frictional resistance ~~becomes great~~ at the time when the positioning pin 105 is pulled out of each suspension element attachment hole 102b becomes great and may cause warping or distortion ~~so that warp or distortion may be caused~~ in the arms 102. Because the arms 102 are formed of a light metal (such as aluminum), ~~The arms 102 are formed of a light metal material, such as aluminum. Therefore,~~ there is a problem that a sinter may easily occur due to the frictional resistance at the time when the positioning pin 105 is pulled out of the suspension element attachment holes 102b.

Furthermore, since the position of the arms 102 are limited by the positioning pin 105 due to resin contraction after injection molding, a problem may occur concerning deformation or

frictional resistance of the suspension element attachment holes 102b. However, it is essential to utilize the above described positioning pin 105 in order to align the suspension element attachment holes 102b of the arms 102 in a coaxial line. ~~Since~~ Because there is some dimensional dispersion in each arm 102, the center of each suspension element attachment hole 102b is shifted in the case that the external form of the arms 102 is referred to for positioning. Therefore, there is a problem wherein it is difficult to attach the plurality of suspension elements by a swaging processing. In addition, warp or distortion occurs in the arms 102 at the time of manufacture and resin burrs also occur in some cases. Therefore, the positioning can not be carried out with respect to a reference of the external form of the actuator. Because of the above reasons, it is necessary to carry out the positioning on the basis of the suspension element attachment hole 102b of each arm 102 in the conventional manufacturing method.

As described above, in the conventional manufacturing method for the rotary type actuator, it is necessary to forcefully press the end portion of the arm 102 into the groove 101a of the holder 101 in order to secure the arm 102 to the holder 101 with reliability. ~~As a result, since~~ Because the frictional resistance at the time of the press fitting of the arm is great, the force required to overcome the frictional resistance may lead to problems wherein the arm 102 is deformed. ~~there is a problem wherein a great stress is applied to the arm 102 so that the arm 102 becomes deformed.~~

Due to the deformation of the arms 102 (caused by the force required to overcome the frictional resistance at the time of press fitting), there is an additional error in the degree to which the layered arms are mutually parallel or in the dimensional precision of the arm attachment positions.

~~In addition, there is a problem that an error is caused in the degree of being mutually parallel of the layered arms or in the dimensional precision of the arm attachment positions due to~~

~~deformation of the arms 102 caused by the stress at the time of press fitting of the arms.~~

Additionally, the residual distortion to the arms at the time of the press fitting causes a problem wherein the degree to which the arms are mutually parallel changes during the operation of the rotary type actuator.

~~Furthermore, there is a problem that the degree of being parallel of the arms changes during the operation of the rotary type actuator due to the residual distortion at the time of the press fitting of the arms.~~

In addition, when the earth pin 110, which is a conductive member, is pressed into the through-holes 102a formed in the arms 102, burrs occur around the through-holes 102a of the arms 102 so as to cause dispersion in the diameter of the through-holes 102a. As a result, the contact condition between the earth pin 110 and each of the arms 102 becomes unstable~~[[,]]~~. This instability causes a problem wherein the plurality of arms 102 of a conventional rotary type actuator, when constructed as described above, do not become of the same potential and lack stability in function. ~~the conventional rotary type actuator which is constructed as described above has a problem wherein the plurality of arms 102 does not become of the same potential and lacks stability in function.~~

The present invention provides a rotary type, actuator, a manufacturing method thereof as well as an arm positioning apparatus, wherein the above described problems in the conventional rotary type actuator are solved so that the arms are attached to the holder with a high precision and residual distortion of the arms does not occur at the time of assembly so as to gain a stable functioning. In the manufacturing method for the rotary type actuator according to the present invention, warp and distortion of the arms can be eliminated so as to carry out the positioning with a high precision utilizing the suspension element attachment holes of the arms and the positioning pin by using the arm positioning apparatus and the degree of being coaxial of the

suspension element attachment hole of each arm can be secured with high precision. ~~highly precisely secured.~~

DISCLOSURE OF INVENTION

A rotary type actuator according to the present invention comprises: arms in a plate shape for holding head suspension elements at one end;

a holder in a cylindrical shape for holding said arms which are oscillated, wherein grooves having a gap width greater than the plate thickness of said arms are formed on the external surface of the holder and the other end of each of said arms is inserted into the grooves;

a single coil part around which a wire is wound in an aligned manner;

a conductive member in a band shape for maintaining said plurality of arms at the same potential through grounding; and

a resin part for integrally combining said arms, said holder and said coil part at a predetermined position. In the rotary type actuator that is configured in ~~such a~~ this manner, the arms can be easily inserted into the grooves of the holder so that no stress is applied to the arms at the time of assembly. Accordingly, no deformation or residual distortion of the arms occurs at the time of assembly in this rotary type actuator. As a result, no error occurs in the degree ~~of being parallel of~~ to which the arms are mutually parallel or in the dimensions of the attachment height due to the deformation of the arms. Additionally, because there are no errors or residual distortion, there is no change to the degree to which the arms are parallel during operation of the rotary type actuator. ~~And no change occurs in the degree of being parallel of the arms due to the residual distortion during the operation of the rotary type actuator.~~

A manufacturing method for a rotary type actuator according to the present invention is a manufacturing method for a rotary type actuator having arms in a plate shape for holding head suspension elements at one end; a holder in a cylindrical shape for holding said arms which are oscillated by supporting the other end of each of said arms; and a single coil part around which a wire is wound in an aligned manner, having:

a step of forming grooves having a gap width greater than the plate thickness of said arms in the external surface of said holder;

a positioning step of positioning in the upward and downward direction by mounting the other end of each of said arms onto each of the upward facing surfaces of said grooves formed on the side of said holder;

a step of connecting a conductive member in a band shape to the respective sides of said arms that are inserted into said grooves of said holder and of said holder; and

a step of holding said arms, said holder and said coil part at a predetermined position while integrally combining said arms, said holder and said coil part by forming a resin part through injection molding. According to this manufacturing method, since the arms can be easily inserted into the grooves of the holder, no stress is applied to the arms at the time of assembly. Accordingly, no deformation or residual distortion of the arms occurs at the time of assembly. As a result, no error occurs in the degree of being parallel of the arms or in the dimensions of the attachment height due to the deformation of the arms at the time of assembly. [[And]] Additionally, the degree of being parallel of the arms does not change due to residual distortion during operation. In addition, according to the manufacturing method of the present invention since the press fitting of an earth pin becomes unnecessary, burrs at the time of press fitting of such an earth pin or defective contacts due to dispersion in the hole diameter do not occur. As a result, according to the present invention, a rotary type actuator that is stable and that has a high precision can be provided. Here, in the manufacturing method of the present invention, it is preferable to secure the conductive member through ultrasonic welding and the conductive member in a band shape can be easily secured to the sides of the arms with a small plate thickness by using ultrasonic welding.

An arm positioning apparatus according to the present invention is an arm positioning apparatus for manufacturing a rotary type actuator which comprises arms in a plate shape for holding head suspension elements at one end, a holder in a cylindrical shape for holding said arms which are oscillated by supporting the other end of each of said arms, and a single coil part

around which a wire is wound in an aligned manner, and secures said arms, said holder and said coil part at a predetermined position by resin molding, and

said arm positioning apparatus comprises:

a positioning pin for positioning said arms by insertion into suspension element attachment holes of said arms which are placed at predetermined positions in said holder; and

a pin positioning means having a pin holder for holding said positioning pin which is movable in the arm positioning direction for positioning said arms at predetermined positions by restricting the movement of said positioning pin at the time of arm positioning and for releasing the restriction to said positioning pin after the completion of arm positioning. According to the present invention, ~~since~~ because the positioning pin is in a freely movable~~,~~ condition at the time of resin molding, after the completion of arm positioning~~,~~ the arms are not restricted by the positioning pin at the time of arm expansion or of resin contraction. In addition, according to the present invention, ~~highly precise~~ high precision positioning of the arms and the degree of being coaxial of the suspension element attachment hole in each arm can be secured. Furthermore, according to the present invention, warp or distortion of the arms can be prevented so that the sinter of the positioning pin in the suspension element attachment holes can be prevented. In addition, the positioning pin can be withdrawn and pulled out of the arms in the condition wherein the arms are secured by a metal mold after the completion of resin molding so that the load to the arms can be reduced in comparison with the conventional system (where the arms are raised and pulled out of the positioning pin; see FIG. 8). ~~(FIG. 8) wherein the arms are pulled out of the positioning pin by being raised.~~ Thereby, warp and distortion of the arms can be prevented.

In a manufacturing method for a rotary type actuator according to the present invention, the rotary type actuator is manufactured by resin molding both sides of a holder member in a cylindrical shape for supporting arms on a chassis so as to rotate, and the arms have head suspension elements having magnetic heads at one end of each arm and a coil member, and the manufacturing method have:

a step of placing said arms at predetermined positions relative to said holder member which is held in a metal mold for resin molding;

a step of carrying out positioning of said arms by inserting a positioning pin in the suspension element attachment holes of said arms so as to restrain and position said positioning pin at a constant axis position;

a step of resin molding said arms by releasing the restriction of said positioning pin after the completion of arm positioning; and

a step of pulling out said positioning pin from said suspension element attachment holes after the completion of resin molding. According to the present invention, ~~highly~~ high precision positioning of the arms and the degree of being coaxial of each suspension element attachment hole in each of the plurality of arms are secured and warp or distortion of the arms can be prevented so that sinter of the positioning pin in the suspension element attachment holes can be prevented.

While the novel features of the invention are set forth particularly in the appended claims, the invention, both as to organization and content, will be better understood and appreciated, along with other objects and features thereof, from the following detailed description taken in conjunction with the drawings.